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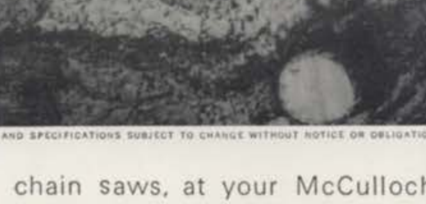

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(continued from front) coarse droplets under a hood close to the ground. The spray pattern leaves no area larger than a dime uncovered ... has standard 36-inch swath. Special 18-inch applicator disc attachment available to give full 72-inch swath. ■ You can't make mistakes with the Meter-Miser because complex metering and calibration is eliminated. Simply half fill the 5 gallon tank with water, add pre-measured container of Amchem Meter-Miser herbicide (choose the right one for each job) and finish filling tank with water and spray. One tankful covers 4,840 square feet.

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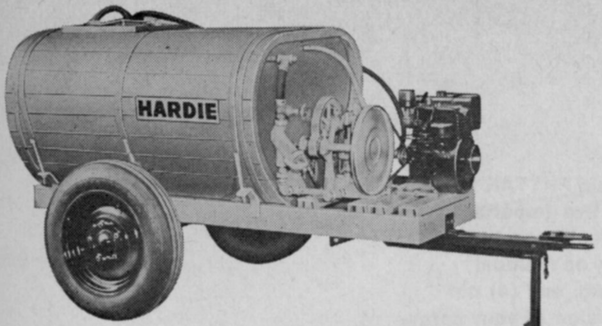
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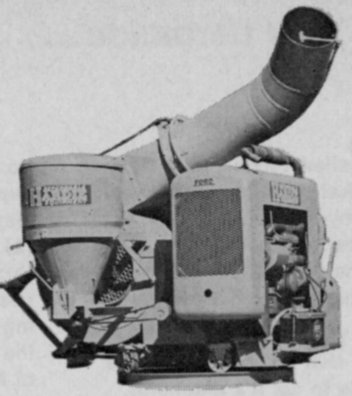

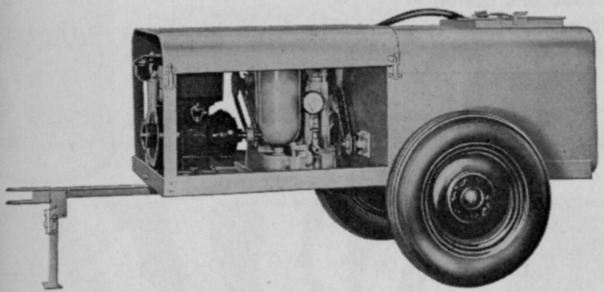

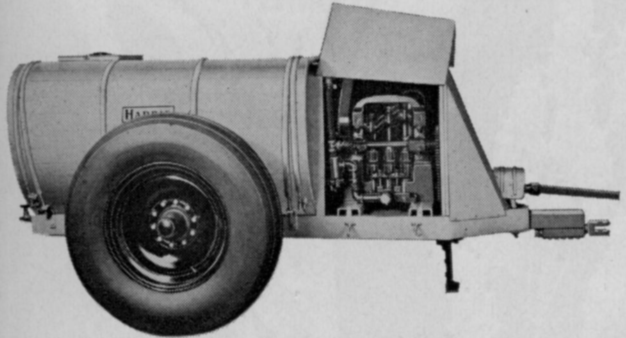

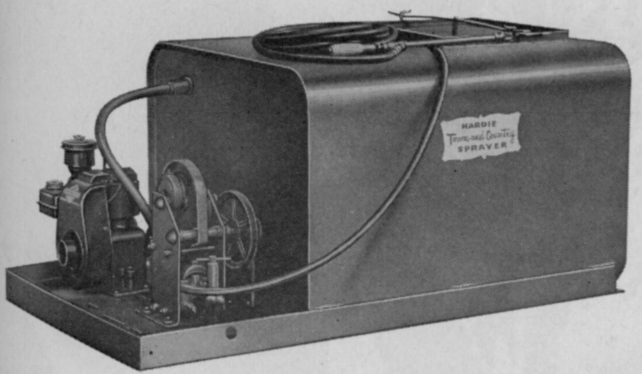
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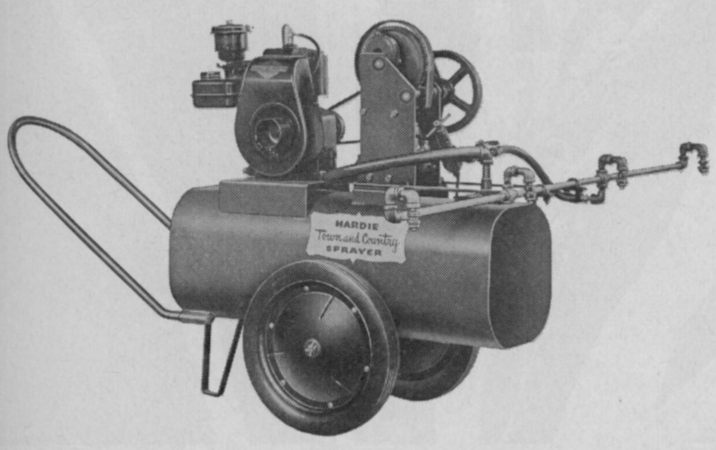
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Ho-hum...
another new herbicide...

This one is called Phytar 560!
You'd think that manufacturers would run out of funny names . . . or would get wise to the fact that farmers are completely confused about all the new herbicides kicking around these days.

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Try it! The name's PHYTAR . . . and it's a product of the Ansul Company, Marinette, Wisconsin.

WEEDS TREES and TURF

FORMERLY WEEDS AND TURF

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Synthetic Turf and Bare Feet

We've been reading in a number of places how man is demonstrating his capacity for improving on nature by scientifically developing substitutions. One of the latest innovations appears to be synthetic turf.

Naturally, we had more than just a passing interest in such materials that simulate the appearance of grass but claim to lack its "flaws," so we sent for some samples.

After examining the little swatches mailed to us, we've come to the conclusion turfmen have nothing to worry about. As my outdoor-loving wife said, "Who'd ever want to walk around in their bare feet on that!"

Granted, the new lawnlike carpeting may enable designers to put the green stuff (although it comes in a number of colors!) into places where turfgrass wouldn't grow anyway, such installations cannot be used in places where man has come to expect the sweet scents of clipped lawn and pungent wet earth, and the miracle of green growing things in their annual cycle of birth and rebirth.

We wondered about a number of angles. No company sent us prices on their turf carpeting, even though we had asked for them. Surely these synthetic ground covers need care, but it is claimed their advantages include mildew, moth, weed, rot, dirt, stain, flame, and stretch *resistance*. Wonder how one keeps them clean, or where the detergent wash water goes when it drains?

Are these grass substitutes strong enough to withstand duffers on a golf green or constant footwear, especially from cleated shoes? It was easy to pull out "tufts of grass" on one of the samples we received, and no matter how hard our yardman tried, he couldn't replace it with a sprig of grass or a planting of seed. How do these easy-to-keep plastic grasses reflect the hot summer sun? Would they feel like the seat of your convertible when its parked with the top down?

Mind you, we're not against progress, and undoubtedly today's entries into the synthetic grass market will improve both in feel and durability, but we're confident manmade turf will have to come a long way before there's even the slightest threat to the future of cultivated sod and those who maintain grass so man can enjoy the greenness of life itself when he steps away from the synthetic tools of his business environment, to relax in nature's great out of doors, to stretch out on the lawn beneath his favorite tree, or experience the refreshing thrill of walking on a dew-covered grass in his bare feet.

Ever see plastic fruit? Looks tempting, but 'tis not very nourishing nor satisfying to the taste.

WEEDS TREES AND TURF is the national monthly magazine of urban/industrial vegetation maintenance, including turf management, weed and brush control, and tree care. Readers include "contract applicators," arborists, nurserymen, and supervisory personnel with highway departments, railways, utilities, golf courses, and similar areas where vegetation must be enhanced or controlled. While the editors welcome contributions by qualified freelance writers, unsolicited manuscripts, unaccompanied by stamped, self-addressed envelopes, cannot be returned.

Liquid vs. Solid *Fertilizers*

By DR. JAMES A. SILVA
Soil Scientist
College of Tropical Agriculture
University of Hawaii, Honolulu

FERTILIZER materials which are in solution, moved and stored in tanks, and transferred through pipes by pumps or gravity are called "liquid fertilizers." Anhydrous ammonia is one example of a liquid fertilizer which is held under pressure. But aqua ammonia, a solution of anhydrous ammonia in water, is a liquid fertilizer which is not held under pressure. Nutrients supplied by liquid fertilizers must be water soluble so they are readily available to plants as long as they remain in solution.

To compare liquid fertilizers with solid forms, first of all, consider the various liquid fertilizers used to supply nitrogen (N), phosphorus (P), and potassium (K).

Ammonia Lost from Liquid

Anhydrous ammonia is ammonia gas kept under extreme pressure so that it is a liquid. This fertilizer, which contains 82% N, must be handled and applied with special high-pressure equipment.

Another widely used liquid nitrogen fertilizer is aqua ammonia; it is simply anhydrous ammonia dissolved in water. This fertilizer contains 15 to 25% N and is not held under pressure, and is much easier and safer to handle and apply than anhydrous ammonia.

Ammonium nitrate, and various ammonium phosphates, are sometimes added to aqua ammonia to obtain a higher ratio of N in liquid mixtures. These materials also are used alone to supply N, or both N and P. Nitrogen often is supplied as urea (a synthetic organic nitrogen carrier) and also by various natural organic nitrogen carriers such as fish emulsions.

One of the difficulties experienced with anhydrous and aqua ammonia is the loss of ammonia by volatilization. This is detected by the smell of ammonia after the fertilizer is applied. When applied to acid soils, ammonia losses may be as high as 15%. On alkaline soils, volatilization losses can exceed 50%. Thus, to minimize loss, it is necessary to inject these materials below the soil surface. Application of anhydrous and aqua ammonia in irrigation water also greatly reduces volatile losses.

The other liquid forms of nitrogen mentioned usually do not volatilize when applied properly. Some of the inorganic forms of nitrogen can "burn" leaves when applied in high concentrations directly on plants. Organic sources of N, on the other hand, are less likely to burn leaves and are preferred for foliar applications.

Phosphorus Popular In Compound Form

Phosphorus is supplied in liquid form as phosphoric acid (H_3PO_4), and also as various ammonium and potassium phosphates. Phosphoric acid, which contains about 24% P is very corrosive and must be handled in stainless steel or rubber-lined containers.

Where soils are very alkaline, phosphoric acid is applied directly to the soil. In most areas, however, phosphoric acid is neutralized by adding aqua ammonia before application. These mixtures are much less corrosive than phosphoric acid, and ordinary steel containers can be used to handle them. Phosphorus found in liquid phosphorus fertilizer is completely water soluble which makes it readily available to plants.

Potassium Chloride: Most Common K Carrier

Muriate of potassium (KCL), or potassium chloride, probably is the most common carrier of potassium used in the liquid form. It is a solution of solid KCL in water. Sulfate of potash and potassium phosphate also are used as liquid carriers. Potassium solutions are very corrosive and proper care of equiment used to handle these solutions must be practiced. However, the addition of aqua ammonia to the KCL solution reduces its corrosive powers considerably.

Various mixtures of N, P, K, and their compounds are used to make liquid fertilizers at different N, P, and K ratios; for example, 15-2-4 and 6-5-10. These mixed fertilizers cannot contain more than about 20% total N, P, and K (by weight), because it is not possible to dissolve more in a given volume of water.

Oxide Statement Confuses

The expression of plant nutrients in the elemental form, P and K, rather than the oxide form, P_2O_5 and K_2O, is being done for greater clarity and simplicity. Although phosphorous and potassium have been expressed as oxides for many years, considerable confusion often occurs in discussing and reporting fertlizer trials, for example. Use of the oxide statement is actually incorrect, since these nutrients are not in the P_2O_5 and K_2O form in fertilizers. These are some of the reasons national soil and agronomic societies recommend the use of the elemental form to denote plant nutrients. It is very simple to convert from one form to the other by multiplying by appropriate factors shown in Table 1.

Liquid vs. Solid Fertilizer

Now that some of the liquid fertilizers have been discussed, let us see how they compare with solid fertilizers.

Liquid fertilizers have several advantages over solid forms, and some are listed below.

1. Convenience in handling; i.e. by pumps and gravity.
2. Easy to obtain uniform mixtures and applications.
3. Easy to place in bands or rows.
4. May be applied with irrigation water.
5. Phosphorus availability increases.

Liquid fertilizers characteristically also have several disadvantages when compared with solids. For example:

1. Liquids corrode metal containers and other equipment.
2. Possibly, nitrogen is lost by volatilization of ammonia in some carriers.
3. Phosphorus is "fixed" in certain soils.
4. Total plant food in solution is limited to about 20%.
5. Larger quantities of liquids must be applied with some carriers to obtain equivalent amounts of plant food supplied by solid forms.

Crop Response Compares Forms

The response of crops to nutrients applied in the two forms is probably the most important comparison. Many experiments have been conducted to compare the yield response from liquid and solid forms of fertilizer. Generally, when properly used, equal response is obtained with anhydrous ammonia and nitrogen solutions as with the same amounts of actual N applied in the solid form.

The sugar industry in Hawaii conducted an extensive series of experiments comparing liquid aqua ammonia and solid ammonium sulfate. No difference in yields of cane or sugar was found.

These results, as well as the fact that aqua ammonia was cheaper than ammonium sulfate, encouraged the industry to shift from solid ammonium sulfate to liquid aqua ammonia.

Coastal bermudagrass yield response to liquid fertilizers was

Table 1. Oxide-elemental Conversion Methods.

Percent or Pounds		Multiply by factor		Converted to Percent or Pounds
Conversion from oxide to element				
P_2O_5	×	0.44	=	P
K_2O	×	0.83	=	K
Conversion from element to oxide				
P	×	2.29	=	P_2O_5
K	×	1.20	=	K_2O

Adapted from: Crops and Soils. 1962. 14:(6):5-7.

Table 2. Yield of Wheat Forage as Influenced by Source of P.
(Norfolk sand loam, Alabama, 1957.*)

Source**	Form	(lbs./A) Dry Forage
None	—	1321
Concentrated superphosphate	solid	1923
Ammonium metaphosphate	solid	1925
Ammonium metaphosphate	liquid	1965
Diammonium phosphate	solid	1920
Diammonium phosphate	liquid	2047
Ammonium superphosphoric acid	liquid	1837
	LSD (.05)	453

*Adapted from: Lathwell, D. J., Cope, J. T. Jr., Webb, J. R. 1960 Agronomy Journal 52:251-254.
**P applied at 9 lb. (20 lb. P_2O_5)/A banded in the row.

Table 3. Comparison of Liquid and Solid Fertilizers for Coastal Bermudagrass
(Cecil sandy loam, Athens, Georgia, 1962.*)

Treatment	Pounds per acre N-P-K	Forage yield /A (Oven-dry) Total of 4 clippings
1. Liquid 14-3-6	100-22-42	2871
2. Solid 16-3-7	100-22-42	3494
3. Liquid 14-3-6	200-44-84	5161
4. Solid 16-3-7	200-44-84	7073
5. Liquid N sep. Liquid H_3PO_4 and KCl sep.	200-44-84	6025
6. Liquid N & H_3PO_4 mixed KCl sep.	200-44-84	6673

*Adapted from: Morris, H. D. 1964. Georgia Agr. Res. Ga. Agr. Exp. Sta. 5:16. (Fertilizer ratios in the original article were in terms of P_2O_5 and K_2O.)

Table 4. Comparison of Liquid and Solid Forms of N for the Application of 50 lb. N per Acre of Turf.

Form of Fertilizer	Liquid	Solid
Source of N	NH_4NO_3	$(NH_4)_2SO_4$
%N in concentrated material	17	21
Dilution of material for application	1:60	none
%N in applied material	0.4	21
Amount of conc. material for 50 lb. N/A	26 gal.	238 lb.
Amount of diluted material applied /A	1,560 gal.	238 lb.
Weight of material applied /A	12,500 lb.	238 lb.

compared to that from solid fertilizers in Georgia. Some data are presented in Table 3. A comparison of treatments 1 and 2, and treatments 3 and 4, shows that liquid fertilizers gave lower yields than solids; this difference being greater at the higher rate of application. The author of that article states that yield difference may be due to plant poisoning by the liquid fertilizer, since foliage on plots that received liquid fertilizer, in any form, was injured. Injurious effects disappear about two weeks after application. The liquid nitrogen used was composed of one-half urea and one-half ammonium nitrate. Concentration of the fertilizer solution was not given, but it appears that the concentration was too high because leaves were burned.

A comparison of treatment 5 with 6 shows a 648-lb. difference in yield in favor of treatment 6. The only difference between these two treatments is that liquid nitrogen in treatment 6 was applied separately, followed by H_3PO_4. The liquid in treatment 8 was mixed with the H_3PO_4 before application, and they were applied together. The author suggests this increased yield is due either to a reduction in loss of nitrogen from urea in the nitrogen solution, a decrease in the phytotoxicity of the materials from mixing, or a combination of these factors. These data emphasize the fact that application of liquid fertilizers in too high concentration can seriously damage grass.

Equal crop response, therefore, has been obtained from the proper application of either liquid or solid forms when the same amount of actual N, P, and K has been applied.

Should You Use Liquid or Solid?

Since liquid and solid fertilizers give the same yield response, which form should be used? In order to answer this question, one must evaluate several factors concerning these two forms of fertilizer. Two of the most important factors are relative cost per unit of plant nutrient and application costs of the two materials. Also considered must be the relative concentrations of nutrients in the final volume of applied material.

Data in Table 4 illustrate some calculations which should be made during the evaluation of the two forms. A liquid nitrogen fertilizer containing 17% N, such as ammonium nitrate (NH_4NO_3), is compared with a solid nitrogen fertilizer containing 21% N, ammonium sulfate ($(NH_4)_2SO_4$). The liquid material weighs about 11.5 lbs. per gallon and is supplied in 30-gal. drums, while the solid material comes in 80- or 100-lb. bags. Manufacturers recommend

(Continued on page 16)

Book Review

Management of Artificial Lakes and Ponds

by George W. Bennett, Reinhold Publishing Corp., 430 Park Ave., N. Y., N. Y. 10022, 1962, 283 pp. $8.00.

Management of Artificial Lakes and Ponds deals with a complex subject. But the author displays an intimate knowledge of limnology, ecology, botany, zoology, ichthyology, conservation, and control, which enables him to sift practical information from a voluminous bibliography of technical material. He includes in his text adequate theory and a maximum of useful advice for those interested in water management.

Contents vary from the history of fish culture, through a discussion of kinds of excavated water bodies as possible habitats for game fish, to a consideration of fish as a productive crop, their reproduction and mortality.

The most important chapter for readers of this magazine is called "Theories and Techniques of Management." Included in this section are subjects of rough fish control and aquatic weed control. Both are dealt with from a management standpoint.

Information on weed and water relationships is invaluable to controllers who seek to make the best possible use of water without nuisance weeds. *Management* is not a handbook for removal of aquatic weeds from standing water, even though it contains a chart of recommended materials and rates to control various weeds. It is designed for the lake manager, whose duty ranges widely, but it is equally useful to the aquatic weed controller seeking new markets for his service. If aquatic weed controllers expect to cultivate business from commercial, municipal, or state recreational establishments, they will have to be familiar with the ideas, and needs of lake, pond, or aquatic game managers. This book helps to supply that familiarity.

Management is easy to read. Author Bennett's style reflects many years of association with people who knew less about limnology and ecology than he, and who wanted to learn. His book conveys concepts in an understandable way: "Prospective homeowners who contemplate purchase of lots for permanent homes on small lakes should insist on a sewage (septic) system which will carry all effluents away from the lake. Effluents from tile fields enter the lake, and because they carry phosphates and nitrates, they act as fertilizers which stimulate aquatic vegetation and create nuisances."

Bennett is a writer with humor: "One type of *Spirogyra* (algae) is notoriously slippery, and once I saw a bather slip and sit down at the top of a steep spirogyra-covered lake spillway and slide entirely to the bottom before he could stop . . . Needless to say, he repeated the act until the algae as well as the seat of his bathing suit was practically gone."

Judging from the scant number of books on this subject, *Management of Artificial Lakes and Ponds* is welcome, and just in time, if not a decade overdue.